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ANALYSIS OF THE INCIDENT OF DECEMBER 31st, 2010

at

Federal-Mogul Corporation
300 Industrial Park
Blacksburg, Virginia

Jeffrey S. Hodges et al.
v.
Federal-Mogul Corporation et al.

In the United States District Court for the Western District of Virginia
Case No. 7:12-cv-00362-MFU

by

Richard J. Roby, Ph.D., P.E.
Technical Director

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Submitted to:

Daniel R. Sullivan, Esq.
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Roanoke, Virginia 24011

October 28, 2013

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This analysis of the fire incident at the Federal-Mogul Corporation in Blacksburg, Virginia, is prepared pursuant to the Federal Rules of Civil Procedure. It is intended to serve as a disclosure of my expert opinions concerning this fire incident. This analysis is based on my review of documents, evidence, and information concerning the fire incident that occurred on December 31, 2010. A list of the material reviewed is given as Appendix A.

In developing my analysis and opinions, I have relied heavily on my knowledge of Combustion and Fire Sciences, Chemistry and Chemical Engineering, Mechanical Engineering, Fire Protection Engineering, Fire Dynamics, Material Flammability, Heat Transfer, Fire Detection, Fire Origin and Cause Investigations, Ignition, Flame Spread, and Fire Toxicology. Additional information on my experience and training is provided in the Resume and List of Publications that are given as Appendix B.

My fee for preparation of this report and for testimony by deposition or in court is $350/hour. A list of my testimony by deposition or in court over the last four years is given in Appendix C.

The analysis and opinions expressed in this report are based on my knowledge of facts and information reviewed to date. All opinions are held to a reasonable degree of scientific and engineering certainty. If my opinions (or the bases for them) as expressed below change or if new opinions are formulated as a result of additional information that becomes available, I will amend or supplement our opinions appropriately.

BACKGROUND

On the morning of December 31st, 2010, LCM Corporation, a company providing industrial waste management services, was undertaking a cleaning job at the Federal-Mogul plant in Blacksburg, Virginia. Federal-Mogul, an auto parts supplier, used an aluminum dust recovery system in the factory which, through suction, took aluminum dust and grinds from an interior brushing operation to an exterior baghouse where they were put into a drum for disposal. The dust removal system included multiple fire protection and explosion prevention measures, including grounding and bonding of all of the components, a flashback damper in the ductwork, and explosion venting on the baghouse.

The day before the cleaning, personnel from LCM were at the Federal-Mogul plant inspecting various ducting runs and found that the particular duct on the aluminum brushing line was dirty and required cleaning. Federal-Mogul contracted LCM to clean the duct the following day. To clean the duct, LCM used a vacuum truck with rigid piping from the truck for some distance, before flexible plastic hosing was attached. The vacuuming operation consisted of removing one piece of the ductwork between the brushing operation and the baghouse and then working both in the direction back toward the brushing operation and out toward the baghouse on the exterior of the building with the vacuum.

Thus, on the morning of the incident, Jeffrey Hodges and Tommy Lee Bonds from LCM were working on a scissor lift near the ceiling and were vacuuming a run of circular ductwork that led from the aluminum brushing operation to the baghouse. In addition to Mr. Hodges and Mr. Bonds on the scissor lift, John Spangler was operating the vacuum truck on the ground and Danny Collins was supervising the operation from below the scissor lift. During the vacuuming operations the workers were wearing Tyvek suits, safety glasses, steel-toed boots, safety glasses, ear plugs, and a half-face respirator. It is unclear if they were wearing hard hats.

After removing a small middle piece of the duct to gain access, Mr. Hodges and Mr. Bonds successfully vacuumed some but not all of the ductwork back toward the aluminum brushing machine. As they began to vacuum in the direction of the baghouse, they noted that the vacuum hose was not long enough so they utilized a piece of PVC piping as an extension. At some point, Mr. Hodges called down to Mr. Collins and Mr. Spangler and asked them to turn down the RPMs on the truck. Shortly after, a loud explosion occurred.

Mr. Hodges has reported seeing a "flash of a fireball" from the baghouse end of the ducting, beyond the backdraft damper, prior to his catching on fire and sustaining his injuries. Mr. Collins says he looked up after the explosion and saw Mr. Hodges and Mr. Bonds on fire. He encouraged Mr. Hodges to lower the scissor lift, at which time he snuffed out the fire on one of the workers while Federal-Mogul employees utilized fire extinguishers to put out the fire on the other worker. Ultimately, Mr. Hodges and Mr. Bonds suffered serious burns to a significant amount of their body area. Mr. Spangler, meanwhile, indicated that his head and hair caught fire and he put the fire out at an eye-washing station. Mr. Spangler also had burns to his head. Finally, Mr. Collins had a cut on his hand. In addition to the injuries, there was also burning to

the inside of the ductwork, and the baghouse outside exploded and had subsequent burning. A security camera inside the Federal-Mogul plant, although not aimed directly at the workers, recorded the incident.

After the incident, the Virginia Department of Labor and Industry cited LCM for failing to ground and bond the vacuuming equipment utilized at the plant the day of the explosion. This lack of grounding and bonding led to the generation of multiple static sparks during the vacuuming operations as reported by the workers.

ANALYSIS OF INCIDENT

At issue in this case are the origin and cause of the incident. Additionally, the responsibility for the damage to the plant and the injuries to Mr. Hodges, Mr. Bonds, and Mr. Spangler needs to be determined.

Origin and Cause

In line with the Scientific Method as defined in *The Guide for Fire and Explosion Investigations* (NFPA 921), in order to determine the definitive origin and cause of the fire, hypotheses need to be formed and then tested to see if they match the evidence in the case as well as the laws of fire physics. In this particular incident, CSE can only identify one possible hypothesis that matches the facts of the case and the laws of fire physics: while workers were vacuuming the dust out of the duct with an ungrounded vacuum, static sparks ignited a cloud of dust that had been agitated by the vacuum. The ignition took place at the tip of the vacuum extension, which was reportedly 8 feet long, so ignition would have taken place 8 feet into the ductwork. After ignition of the dust, the deflagration wave traveled in both directions, toward the workers as well as toward the baghouse. Even though the dust was not initially agitated in the area of the ductwork remote from the workers, the pressure wave from the deflagration, which precedes arrival of the flame front, agitated the rest of the dust in the ductwork and the flame proceeded all the way to the baghouse. The deflagration that traveled toward the workers would eject out the ductwork right onto them, igniting their clothes, and leading to their injuries. Meanwhile, the deflagration wave that traveled to the baghouse caused a considerable explosion and overpressure event due to the large amount of fuel present in the baghouse.

As additional support of this hypothesis, Mr. Hodges has indicated that the vacuuming was indeed causing some static sparks that he could feel. LCM workers have indicated that typically whenever they were getting some static sparks, they would instruct the truck operator to turn down the RPMs on the vacuum, as the static sparks can be uncomfortable for the operator of the vacuum. In the moments leading up to the incident, Mr. Hodges had called down to Mr. Collins and Mr. Spangler and told them to turn down the RPMs on the truck. Mr. Hodges' request is a likely indication that he was having issues with static sparking. A situation where workers vacuuming would be kicking up a dust cloud while the vacuum was producing static sparks would create an incredibly dangerous situation that would be expected to result in a dust cloud deflagration.

CSE considered the hypothesis that the incident originated in the baghouse, where an explosion occurred, and traveled back through the ductwork to where the workers were vacuuming the duct. CSE was able to discard this hypothesis for several reasons. First, contrary to the opinions of Plaintiffs' experts, CSE is of the opinion that the video footage from the security camera indicates that the first flash occurred inside the plant, not outdoors at the baghouse. Specific discussion of the video footage is included later in this report. Secondly, the post-incident condition of the ductwork inside the plant is indicative of an explosion starting inside the plant, not outdoors. As can be seen in Figure 1, the section of the ductwork heading toward the baghouse is displaced axially in the direction of the baghouse, not vice versa. The wires holding up the ductwork on the right where the explosion occurred are bent in an angle to the right, showing how the ductwork moved toward the baghouse, in marked contrast to the wires on the right of the figure, which remain vertical and hold the ductwork in its original position. Had the initial explosion occurred in the baghouse, the pressure wave would have displaced the ducting in the opposite direction, that is, away from the baghouse.

Because there was a flash-back damper in the ductwork between where the workers were vacuuming and the baghouse, had the explosion started in the baghouse, the pressure wave force on the damper would have displaced the entire piping back toward the inside of the building. In this case, the exact opposite occurred.

Figure 1. Post-incident view of the ductwork where the workers were working. Annotations of displacement toward baghouse added by CSE.

Finally, no known ignition source was present in the baghouse except a flame propagating from ignition at the vacuuming location. The baghouse was apparently grounded and bonded and had had no known issues in the past.

Plaintiffs' experts have opined that an exothermal reaction caused by the aluminum dust in the baghouse coming in contact with condensed liquid water from the warmer air inside the plant was the cause of the explosion in the baghouse. CSE was also able to discard this hypothesis. Plaintiffs' experts have speculated that warmer air from the interior of the plant traveled through the ductwork to the baghouse even though the baghouse fan system was not operating and, once the warmer air encountered cold temperatures outdoors, moisture in the air condensed, mixed with the aluminum dust, and ignited. However, such a scenario was not possible in the Federal-Mogul case.

In a location such as an industrial plant where there is no active humidification of the air, the absolute humidity, which is the amount of water vapor present in a unit volume of air, is the same between the indoors and the outdoors. The commonly used measure of the absolute humidity is the dew point, which is the temperature at which moisture will condense from air. As can be seen in Figure 2, at the time of the incident, the temperature in Blacksburg, Virginia, was higher than the dew point, and had been for over an hour before the incident. Because the absolute humidity and therefore the dew point between the indoors and outdoors would be same even though the temperature was warmer inside, no condensation would occur when the warm air moved to the cold outdoors, and ergo, no exothermic reaction could be initiated. This phenomenon can be explained in more pragmatic terms by utilization of the example that when opening the door from an indoor space like the Federal-Mogul plant into a cold outdoor space, a person is not immediately engulfed in a cloud of water vapor and condensation.

Hourly Weather History & Observations

Time (EST)	Temp.	Dew Point	Humidity	Pressure	Visibility	Wind Dir	Wind Speed	Gust Speed	Precip	Events	Conditions
8:40 AM	30.2 °F	28.4 °F	93%	30.20 in	7.0 mi	Calm	Calm	-	N/A		Clear
9:00 AM	32.0 °F	28.4 °F	87%	30.20 in	7.0 mi	Calm	Calm	-	N/A		Clear
9:20 AM	33.8 °F	28.4 °F	81%	30.22 in	7.0 mi	Calm	Calm	-	N/A		Clear

Figure 2. Weather for Blacksburg, Virginia, the morning of the incident. The incident occurred at approximately 9:30 am.

As an additional consideration, the ductwork is always sucking air from the interior of the plant and sending it outside to the baghouse through the ductwork when the equipment is in use. Under this exothermic reaction theory propounded by Plaintiffs' experts, this proposed condensation would be occurring all the time in the baghouse. However, they provide no explanation as to why the explosion happened on this particular day, but never during the previous years of utilizing the dust collection system.

In sum, CSE finds that the exothermic reaction in the baghouse hypothesis can be discarded. Conversely, the hypothesis that the dust was ignited by the workers vacuuming with ungrounded and unbounded equipment cannot be eliminated and fits the known facts of the incident and the laws of fire physics. Since the static spark ignition of a dust explosion during

the vacuuming is the only hypothesis that does so, this hypothesis is the definitive origin and cause of the incident in line with the Scientific Method of NFPA 921.

Responsibility

The responsibility for the injuries to the workers lies solely with the workers themselves and with LCM Corporation, who employed and trained the workers who were vacuuming the ductwork. As explained above, the workers who were vacuuming the ductwork failed to ground and bond their vacuuming equipment, and the resulting static caused the incident. By failing to properly ground and bond the vacuuming equipment while removing an ignitable aluminum dust, the workers provided both the airflow necessary to create a flammable aluminum dust cloud and the static spark necessary to ignite the dust cloud. Thus, the workers operating the vacuum in a hazardous, reckless, and negligent manner caused the incident.

Further, depositions with the workers' supervisor, Mr. Collins, indicate that all of the LCM employees on the jobsite that day, including himself, did not understand or appreciate the risks associated with the vacuuming of aluminum dust. Specifically, they indicated that they did not even know that aluminum dust was ignitable.

This lack of appreciation for the risks of vacuuming aluminum dust was further demonstrated by the use of combustible Tyvek suits instead of fire resistant protective gear. Had fire resistant protective gear been used, the workers' injuries would have been significantly reduced, as a majority of their injuries occurred due to the ignition of the Tyvek suits which then burned on their bodies for a significant period of time before the scissor lift was lowered and the flames could be put out.

Federal-Mogul had no responsibility for the injuries to the workers whatsoever. They had dutifully contracted with the other defendants to design and install the dust collection system. Additionally, when they suspected that the ductwork may have needed cleaning, they hired a purported expert in LCM Corporation to inspect the ductwork and then to clean the aluminum brushing ductwork after it was found to be dirty. In all cases, Federal-Mogul was acting to maintain a safe and effective dust collection system in their plant and cannot be held responsible for the fact that LCM Corporation was careless and negligent during vacuuming operations. In fact, as a result of this incident, of which they had no responsibility, Federal-

Mogul sustained significant property damage to their dust collection system, including the ductwork and baghouse, and likely had significant business loss as well.

The other defendants, Carrington Engineering, Dustex, and Kirk and Blum, also do not have any responsibility for the injuries to the workers, as the workers would have been burned regardless of the performance of the dust collection and fire protection systems because the first deflagration started upstream of those systems and would have burned the workers.

In sum, CSE is of the opinion that this incident was caused by the ignition of aluminum dust by static ignition from the ungrounded vacuum operations of LCM employees. The hypothesis that this incident originated in the baghouse from an exothermic reaction between aluminum dust and condensate can be discarded as being inconsistent with the evidence in the case and the laws of fire physics. Due to the ignition of the dust inside the plant by the workers, the performance of the fire protection systems is irrelevant. The responsibility for the injuries to the workers lies solely with LCM Corporation.

ANALYSIS AND REBUTTAL OF PLAINTIFFS' EXPERTS

Patrick McGinley, Patrick J. McGinley Associates, Inc.

Patrick McGinley, a fire cause and origin investigator, has submitted a report in this matter on behalf of the Plaintiffs. In his report, he opines that while the vacuuming work does indeed produce sparks, the ignition of the dust was caused by an exothermic reaction at the baghouse. He opines that the exothermic reaction was caused by condensation of moisture from the air in the baghouse. He additionally bases this incident cause on the damage to the ductwork and his interpretation of the video footage, as well as the testimony of Mr. Hodges. Regarding Mr. McGinley's opinion, the potential of an exothermic reaction due to water condensate, as described above, is simply not physically possible in this case. While it is true that air can cause condensate when cooled to below its dew point, in this case, the absolute humidity inside the plant and outside the plant would be similar if not identical. Many people often notice the low absolute humidity in their homes in the winter where they will notice static sparks when they are just walking around. Since the outside temperature was above the dew point at the time of the incident, there would be no condensation forming in the baghouse and, hence, no opportunity for an exothermic reaction. Additionally, though, Mr. McGinley provides no explanation for why

the exothermic reaction occurred on this particular date and time instead of any other time. The dust collection process has always gathered air from inside the plant and has always taken it to the baghouse, which is located in the outside air. Yet there have been no reports that CSE is aware of where Federal-Mogul was experiencing fires or exothermic reactions occurring in the baghouse for the years leading up to the incident in question.

As it relates to the damage to the cylindrical ductwork inside the plant, Mr. McGinley is of the opinion that there would have been far more damage to that ductwork had the explosion started inside the plant where the workers were vacuuming. Again, Mr. McGinley is mistaken regarding the amount of damage that would be expected from an internally ignited dust deflagration. Due to the fact that the ductwork is cylindrical and has considerable hoop-strength and was open to the room due to the removed section of duct, the ductwork can withstand a significant overpressure without bursting. Additionally, when ignited inside the ductwork, the deflagration has a place to initially vent, right out the open ductwork onto the workers. With this venting available, there was no need for the pressure to vent elsewhere and cause damage to the ductwork. Furthermore, Mr. McGinley completely ignores the axial displacement of the entire ductwork (see Figure 1). The axial displacement toward the baghouse instead of toward the workers is indicative of the initial pressure wave originating inside the plant.

Important evidence in this case has also been provided by the videotape footage from the security camera inside the plant. After viewing and analyzing the video footage, CSE strenuously disagrees with Mr. McGinley's opinion that the video footage "clearly shows the initial flash of light and blast occurring outside the building exterior wall, not inside." In fact, as will be discussed below, the video footage clearly supports the occurrence of the initial flash inside the building.

First, the camera location in relation to the worker location is shown in Figure 3. As can be seen in the floor plan, the camera is a significant distance from the workers as well as the baghouse and does not have a direct line of view to either location. As can be seen in Figure 4, the very first frame that shows the incident depicts the entire field of view of the camera being saturated by a flash. Since the entire field of view is illuminated, not just the door looking outside, this is supportive that the first flash occurred inside the plant, not outside.

Second, when the contrast is altered on the video footage, one can still see out the door, while most of the interior is still saturated, which is indicative that the flash originated inside, not outside. This phenomenon can be seen in Figure 5.

Third, the shadowing of the pallets indicates that the source of the light is coming from the left, where the workers were vacuuming inside the plant, as shown in Figure 6. If the source of the light had come from outdoors on the right, then the shadowing of the pallets would have been in the opposite direction.

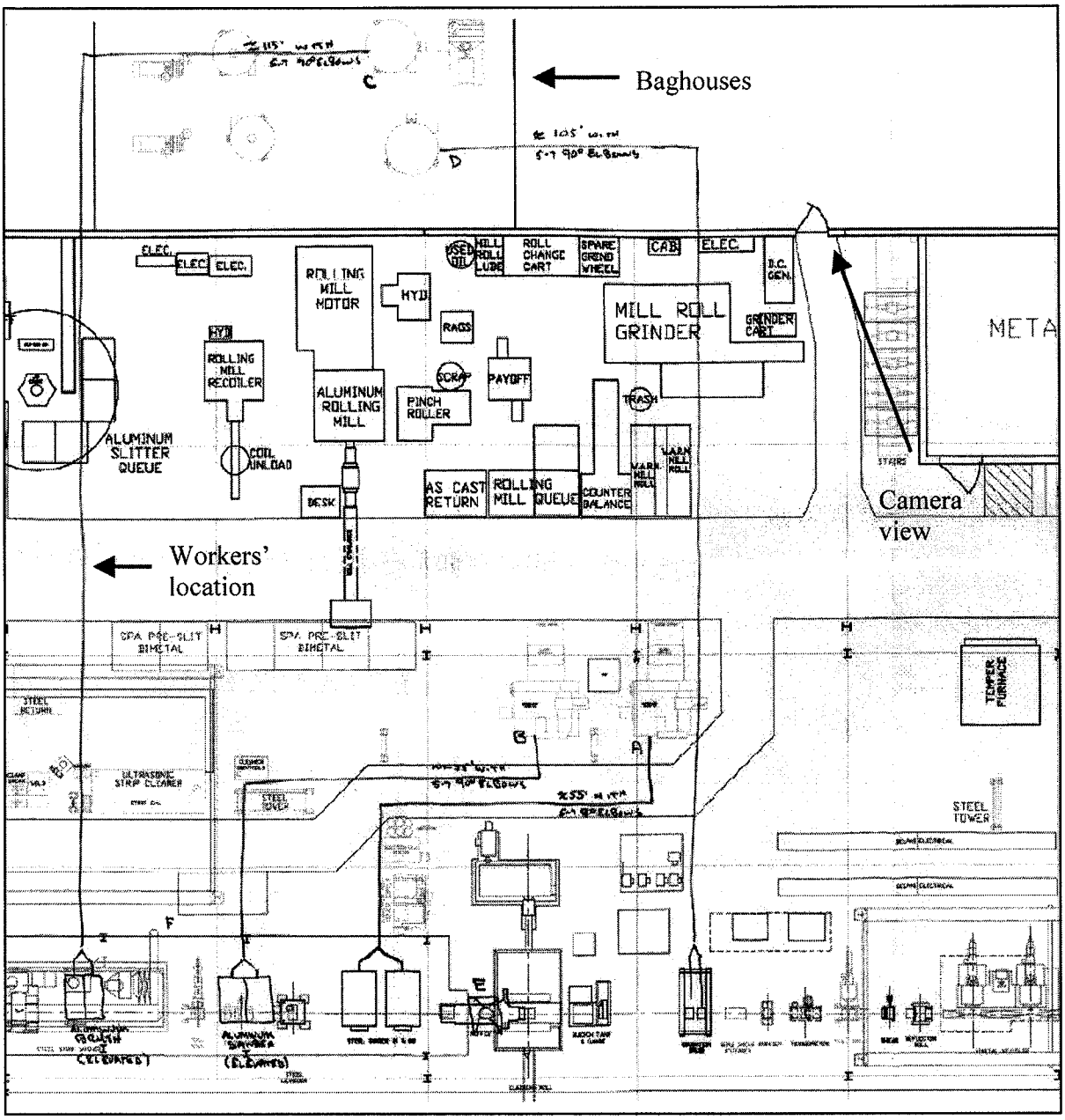

Figure 3. Floor plan of the plant area and baghouses. Annotations in red added by CSE.

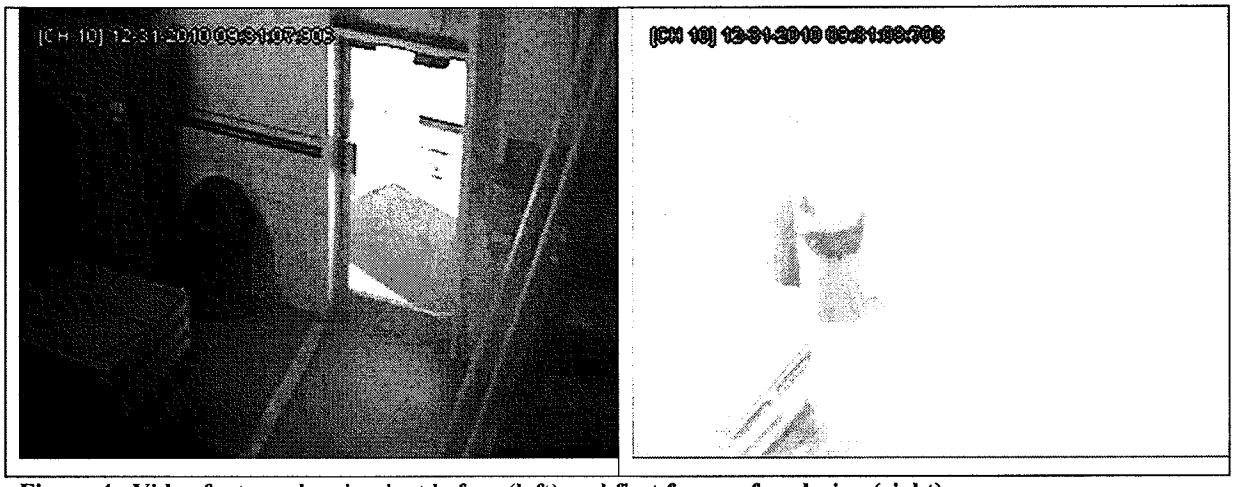

Figure 4. Video footage showing just before (left) and first frame of explosion (right)

Figure 5. Video footage of first flash with contrast elevated showing some portions of frame are still saturated while outside door is still discernible. Annotations added by CSE.

Figure 6. Initial flash showing shadowing to the right of the trashcan and pallet pile indicating the source of the light is from the left.

Further, the testimony of Mr. Hodges that he saw the flame traveling from beyond the backdraft protection toward him is unreliable. While Mr. Hodges may have been looking down into the ductwork at the time of the incident, he had approximately 8 feet of extension on the vacuum that he had inserted down the ductwork, so the ignition point would have been 8 feet down the duct from his location. Mr. Hodges would have had difficulty in identifying the origin of the flame, because the flame was traveling in both directions from where it was ignited at a very fast speed, both toward him and toward the baghouse, and he may have perceived that the flame was beyond the backdraft protection when he first saw it. However, his observations are not as reliable as the known physical evidence in this matter and the laws of physics, and can be explained as unreliable when carefully examined as required by NFPA 921.

In sum, Mr. McGinley has inappropriately discarded the hypothesis of the workers igniting the dust by static during vacuuming due to an improper assessment of the physical evidence, the eyewitness testimony, and the video footage from the security camera. Meanwhile, he has incorrectly determined the area of origin of the incident, and this error has led him to an incorrect and physically impossible cause of the incident. There is no evidence that an exothermic reaction at the baghouse was the cause of this incident.

Martin Schloss, Schloss and Associates

Martin Schloss, an additional cause and origin investigator, has submitted a report in this matter, also on behalf of the Plaintiffs. Mr. Schloss has numerous opinions, including that the ignition of the incident originated in the baghouse, not inside the plant. He also opines that the explosion venting on the baghouse and the design of the backdraft preventer damper were both inadequate. Finally, he attributes the responsibility for the incident not only to the designer and manufacturers of these fire protection systems, but also to Federal-Mogul, since it was their plant.

Regarding the origin and cause of the incident, Mr. Schloss generally relies upon the video footage as well as the testimony of Mr. Hodges. He also addresses why he is of the opinion that the incident did not occur during normal operation for the years leading up to the incident. Regarding the testimony of Mr. Hodges that he could see the flame traveling from beyond the backdraft damper toward him has been addressed previously in the rebuttal to Mr. McGinley. That rebuttal would apply to Mr. Schloss's opinions as well.

Regarding the video footage, Mr. Schloss does offer some further discussion than that provided by Mr. McGinley. He indicates that the first flash engulfs the right side of the frame, which he would expect from an explosion initially occurring outside at the baghouse. CSE disagrees with that assessment. The initial flash, if occurring outside, would only potentially come in the doorway and would not totally engulf the frame. Analysis of the contrast on the video indicates that the flash did not originate outside the door (see Figure 5). Additionally, the shadowing indicates that the flash came from the left of the field of view, where the workers were vacuuming inside (see Figure 6).

Secondly, Mr. Schloss indicates that during the second flash, the glass door opens slightly, indicating that a pressure rise has occurred inside the plant. CSE agrees with this assessment, but disagrees that this is inconsistent with the explosion starting at the interior of the plant. The first flash is clearly from the interior saturating the entire frame. The first flash is the deflagration emanating from the ductwork onto to the workers, igniting their clothing. The first flash on the video can be seen at 9:31:08:703 and the door appears to be opening slightly from the pressure at 9:31:09:109 and for sure is open at 9:31:09:312. This is a difference of approximately 0.406 - 0.609 seconds. The speed of light is approximately $3x10^8$ m/s while the speed of sound is approximately 343.2 m/s (1126 ft/s). Therefore, due to the difference in the speeds of light and sound, the flash would be seen on the video immediately, but the pressure wave which travels approximately at a maximum of the speed of sound for a deflagration would arrive some time later. A pragmatic example of this phenomenon is that one can determine how far away a thunderstorm is due to the difference in time from when lightning can be seen and a subsequent clap of thunder can be heard. In the case of the Federal-Mogul plant, the door would not open until the entire space was pressurized. Therefore, while the door is approximately 100 ft. from the location of the workers, the building is approximately 500 ft. long. The pressure wave would have to travel to all the exterior walls and bounce off and have nowhere to vent before it would force open the door to pressurize. Given the location of the workers in the plant (~40 ft. from the exterior wall), the wave would have had to travel many hundreds of feet to reach the farthest corners of the building. Since a deflagration pressure wave can travel at most about 400-700 ft. in the time durations seen on the video footage and that there would be some time for the deflagration pressure wave to accelerate to near the speed of sound, this timing is highly consistent with the incident starting inside where the workers were vacuuming. The first flash is the workers igniting the dust with static. The door opens less than a second later from the resulting pressurizing of the interior of the plant.

Moreover, the explosion of the baghouse would not be observable on the videotape as a bright flash saturating the frame, because the other baghouse is blocking the field of view to the incident baghouse. While not properly diagrammed on the plans in Figure 3, Figure 7 shows that from the approximate location of the door that is being shown in the video footage, an undamaged baghouse blocks the field of view to the incident baghouse. It is highly unlikely that

any of the flashes on the video footage are from the incident baghouse somehow reflecting off other objects, into the vestibule, to the level of brightness resulting in complete saturation of the frame. Additionally, the vestibule is solid, not glass, and therefore the light would have had to travel through two glass doors, the first into the vestibule and the second at a different angle, into the plant where the camera was located. Therefore, CSE is of the opinion that all of the flashes seen on the videotape are coming from the interior of the plant where the workers were working. The first flash was the ignition of the dust by the workers. The movement of the door was due to overpressurization from the deflagration. Subsequent flashes are either from the deflagration wave coming back inside from the baghouse or from the fact that the workers' Tyvek suits were now engulfed in flames.

As final proof that the video footage indicates that the incident was ignited first where the workers were located is the presence of broken glass from the outdoor vestibule door. In the video, the first flash occurs at 9:31:08:703. After this flash, the overpressure occurs indoors which pushes open the interior glass door. Finally, though, at 9:31:10:312, glass shards can first be seen in the vestibule from the breaking of the outdoor glass door of the vestibule. This is shown as Figure 8. Since this outdoor glass door broke, but not the indoor door, this is an indication that the glass is from the baghouse exploding. Because this glass breakage occurs after the flash and the overpressure inside, this is further proof that the initial flash(s) are not from the baghouse exploding as Mr. Schloss indicates, and in fact, are from the workers igniting the dust while vacuuming. After the workers ignite the dust, the deflagration travels to the baghouse causing it to explode which breaks the glass as seen on the video.

Figure 7. View from the rooftop just above the vestibule and doorway portrayed in the video footage showing one baghouse blocking the field of view to the incident baghouse.

Figure 8. Videotape footage showing the first moment broken glass can be seen in the vestibule. Annotation added by CSE.

Mr. Schloss does address his hypothesis that the explosion at the Federal-Mogul plant was an exothermic reaction in the baghouse and why the incident occurred on this particular day instead of any other day. However, in his analysis of NFPA requirements, he misrepresents sections of the NFPA standard that have nothing at all to do with the potential to cause an exothermic reaction. He states that the NFPA requirements dictate that make up air for the building heating and cooling shall have a dew point low enough to ensure that no moisture can condense on aluminum dust. He goes on to state a requirement in NFPA 651 (now NFPA 484) that "ventilation shall be provided during cleanup to avoid concentrations of hydrogen from the exothermic reaction of the aluminum with water." He indicates that when the machinery is in operation, the air movement is essentially providing this ventilation.

However, Mr. Schloss' opinion is not supported by the NFPA standard, or by the known facts in this case. First, as discussed above, the condensation of water vapor in air will only occur if the temperature of the air drops below its dew point. When the dust collection machinery is normally running, it draws the same indoor air that was available in the ductwork when the workers removed part of it. However, since the inside air and outside air differ only in temperature but not in dew point, simply moving air from inside the building to outside the building will not result in water condensation. Since Federal-Mogul had not had an exothermic reaction incident in the years leading up to the cleaning, this confirms that the indoor air is already maintained at a low enough humidity to avoid significant condensation on aluminum dust in the baghouse. Therefore, not only does Mr. Schloss' opinion fail to explain the current incident, his theory does not explain why an exothermic reaction did not occur in the years leading up to the incident instead of on the one day when the workers were vacuuming.

Additionally, Mr. Schloss is grossly misrepresenting the requirements of the NFPA code. While it is true that the NFPA code mandates keeping moisture away from the dust, the section of the code Mr. Schloss is referring to regarding providing ventilation during cleanup is actually discussing the cleanup of wet powder after a fire has been extinguished by water. The exothermic reaction of water with aluminum releases hydrogen gas into the air as well as heat, and the ventilation requirement is to ensure that hydrogen gas does not build up to an unsafe level for personnel respiratory safety during cleanup after water was used to suppress a fire. The ventilation is also to ensure that the hydrogen gas does not build up sufficient concentration into a flammable mixture. The ventilation requirement has nothing to do with avoiding an exothermic reaction from condensation and is not applicable to the situation at the Federal-Mogul plant. Mr. Schloss's assertions to the contrary are completely misleading.

Furthermore, it is unclear if Mr. Schloss and Mr. McGinley are of the opinion that the explosion in the baghouse was caused by hydrogen gas or by combustible dust. It should be noted, though, that hydrogen gas is highly buoyant due to its low molecular weight and, therefore, it would not likely build up considerably in the baghouse in amounts necessary to create an explosion. Mr. Schloss and Mr. McGinley also provide no information on what would have actually ignited such hydrogen gas or aluminum dust in the baghouse. They have shown no calculations, experiments, modeling, or otherwise to demonstrate the potential of the exothermic

reaction itself to ignite the dust or hydrogen gas. This failure to test their hypothesis is a violation of the Scientific Method. CSE is aware of no known ignition sources in the baghouse.

Mr. Schloss goes on explain that the explosion venting was undersized and that the flash-back damper had an inadequate strength to stop a deflagration from the baghouse from re-entering the building. CSE has evaluated the fire and explosion protection systems in place at the Federal-Mogul plant, specifically the backdraft damper and the explosion venting on the baghouse itself. The explosion venting sizes are mandated by NFPA 68, "Explosion Protection by Deflagration Venting". The standard includes a method by which calculations can be performed to determine the minimum size of the explosion venting. The calculations can be made specific for aluminum dust as the fuel, as well as for the burst pressure of the vents and the structural strength of the pressure vessel, or in this case, the baghouse. Based upon preliminary calculations by CSE, it appears that the explosion venting was undersized for the baghouse if aluminum dust was being captured. This is somewhat verified by the fact that post-incident photographs of the baghouse show that despite the explosion vent operating and opening, there is considerable structural damage to the baghouse. This indicates that, ultimately, the explosion venting was unable to vent the pressure buildup sufficiently to avoid failure of the structure. It should be noted that these calculations include some assumptions regarding the strength of the vessel and the volume of the baghouse. Should more information become available regarding these variables, CSE will re-assess its calculations.

There was also a backdraft damper in the ductwork between the baghouse and where the workers were vacuuming. The purpose of the backdraft damper is to prevent a deflagration wave from proceeding from an incident in the baghouse into the interior of the plant. But since the deflagration wave started inside the plant where the workers were vacuuming and traveled outside to the baghouse, the performance of the backdraft damper is irrelevant as it was not designed to stop a deflagration that originated indoors from heading to the baghouse.

Regardless of their performance, the fire protection systems in this case are irrelevant. Had the incident started in the baghouse, as postulated by Plaintiffs' experts, then perhaps the failure of these systems to prevent a deflagration and pressure wave from re-entering the structure would have been meaningful. But as discussed in the origin and cause analysis above, the incident started inside the plant where the workers were vacuuming. Therefore, before the

deflagration traveled to the baghouse and ignited the large amount of fuel, the initial deflagration wave traveled from the ignition point 8 feet into the ductwork out the opening created by the workers and exposed them to a large flame. This aluminum dust cloud flame had a high adiabatic flame temperature and ignited the Tyvek suits nearly immediately. In other words, regardless of the performance of those fire protection systems, the workers clothes still would have been ignited and, consequently, their injuries still would have occurred. Therefore, Carrington Engineering, Dustex, and Kirk and Blum have no responsibility for the injuries to the workers as the performance of the fire protection features is irrelevant in this incident.

Mr. Schloss attributes some of the responsibility for the losses in this case to Federal-Mogul. He primarily states that all of the opinions he has regarding the deficiencies of the fire protection systems apply to Federal-Mogul as well, since they owned and operated the plant. He goes on to state that the fact that Federal-Mogul employees may have indicated at some point that they rarely, if ever, had to empty the drum at the bottom of the baghouse indicates that there was a malfunction with the system that Federal-Mogul should have known about. Federal-Mogul, however, hired outside firms with the appropriate expertise to design and install the entire system. Therefore, they had no role whatsoever in any of the alleged deficiencies in the fire protection system. Also recall that it is CSE's opinion that these alleged deficiencies played no role in the workers' injuries anyway. As for the operation of the system, Federal-Mogul obviously hired LCM Corporation to inspect the ductwork. Whether this request for an inspection was the result of an observation that some of the dust might not be making it all the way to the baghouse is unknown. But regardless, Federal-Mogul actively sought an inspection of the ductwork by LCM Corporation and upon finding that the duct had dust in it, they promptly contracted LCM Corporation to clean the ductwork. Any opinion that Federal-Mogul was responsible for the injuries to the workers is unfounded. In fact, Federal-Mogul sustained significant damage to property and loss of business due to the hazardous, careless, and negligent actions of LCM Corporation.

In sum, Mr. Schloss is mistaken regarding the origin and cause of this incident. The hypothesis that this incident started outdoors at the baghouse is not supported by the known facts in this case or by the laws of physics. He is misinterpreting the video footage and, further, he is misrepresenting the code requirements when trying to explain why an exothermic reaction

happened on this particular day. Meanwhile, he ignores the obvious conclusion that this incident originated at the vacuuming location and was caused by ignition of a dust cloud by static electricity. His opinions regarding the deficiencies in the fire protection systems are irrelevant because the incident originated where the workers were vacuuming and, hence, they would have been burned anyway. Finally, his opinions regarding the responsibility for this incident are incorrect based on an incorrect conclusion as to the origin and cause of the incident.

SUMMARY OF OPINIONS

The following opinions are held to a reasonable degree of engineering and scientific certainty:

- The ignition of the aluminum dust occurred due to static sparking from an ungrounded vacuuming process conducted by LCM Corporation. The deflagration burned the workers and traveled to the baghouse, causing it to explode.

- An exothermic reaction of aluminum dust and condensed water in the baghouse was not the cause of this incident. The absolute humidity was above the dew point and the same air from inside the plant has always been transported to the baghouse without incident.

- The workers themselves and LCM Corporation are responsible for this incident. Hazardous, careless, and negligent vacuuming procedures including not grounding and bonding the equipment, failure to use fire protective gear, and a lack of appreciation and knowledge regarding combustible dusts led to the injuries to the workers.

- Federal-Mogul and the other defendants had no responsibility for the injuries to the workers.

- Plaintiffs' experts' opinions that the video footage clearly shows that the incident originated at the baghouse are incorrect. The lack of a line of sight to the incident baghouse, the contrast at the door, the shadowing of some of the objects, and the glass breakage in the vestibule renders their opinions regarding the video unreliable. CSE is of

the opinion that the video footage is consistent with the workers starting the incident while vacuuming.

- Plaintiffs' experts' opinions regarding any purported deficiencies in the fire protection systems in the plant including the explosion venting on the baghouse and the flashback damper in the ductwork are irrelevant as the incident originated inside the plant and the workers would have been burned regardless.

- Mr. Schloss' opinion regarding why the shutdown of the equipment resulted in a heightened likelihood of an exothermic reaction is not rooted in science or common sense. Additionally, he misrepresents sections of the NFPA standard that have nothing to do at all with the prevention of an exothermic reaction.

REFERENCES

NFPA 68, Standard on Explosion Protection by Deflagration Venting, 2007 edition.

NFPA 69, Standard on Explosion Prevention Systems, 2008 edition.

NFPA 77, Recommended Practice on Static Electricity, 2007 edition.

NFPA 484, Standard for Combustible Metals, 2012 edition.

NFPA 654, Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids, 2006 edition.

NFPA 921, The Guide for Fire and Explosion Investigations, 2011 edition.

Appendix A

List of Reviewed Materials

- Deposition of Danny Collins, with exhibits, dated 7/24/2013
- Deposition of David Garard, with exhibits, dated 11/13/2012
- Deposition of Ed Thompson, with exhibits, dated 7/24/2013
- Deposition of Jeffrey S. Hodges, with exhibits, dated 5/23/2013
- Deposition of John Paul Spangler, with exhibits, dated 5/24/2013
- Deposition of Tommy Lee Bonds, with exhibits, dated 5/23/2013
- Plaintiff Tommy Lee Bonds' Rule 26(a)(2) Disclosures, dated 9/27/2013
- Plaintiff Jeffrey S. Hodges Rule 26(a)(2) Disclosures, dated 9/27/2013
- Plaintiff John Paul Spangler's Rule 26(a)(2) Disclosures, dated 9/27/2013
- Report of Charles M. Pruitt, Integrity Forensics, LLC, dated 9/26/2013
- Report of Martin Schloss, Schloss & Associates, dated 9/27/2013
- Report of Patrick J. McGinley, Patrick J. McGinley Associates, Inc., dated 9/27/2013
- First Amended Complaint, dated 12/24/2012
- Defendant Q-Tech Equpment (sic) & Services of the Carolinas, L.L.C., D/B/A Carrington Engineering Sales' Answers and Responses to Plaintiffs' Second Interrogatories and Request for Production of Documents, dated 8/14/2013
- Defendant Q-Tech Equipment & Services of the Carolinas, L.L.C., D/B/A Carrington Engineering Sales' Answers and Responses to Plaintiffs' Second Interrogatories and Request for Production of Documents, dated 8/14/2013
- Defendant Dustex Corporation's Answers to Plaintiffs' Interrogatories and Responses to Requests for Production of Documents, dated 7/11/2013
- Defendant Dustex Corporation's Answers to Plaintiffs' Second Interrogatories and Responses to Request for Production of Documents, dated 7/11/2013
- Dustex production documents, bates HLF0001-HLF0135, various dates
- Dustex production documents, bates HLF2883-HLF2884, dated 9/16/2002
- Federal Mogul's Responses to the Plaintiffs' First Discovery Requests, dated 7/3/2013
- Defendant Federal-Mogul's Responses to Plaintiffs' Second Discovery Requests, dated 7/18/2013
- Federal-Mogul production documents, bates DEFFM00001-DEFFM00313, various dates

- Federal-Mogul production documents, bates DEFFM00314-DEFFM00363, various dates
- Defendant's Answers and Objections to Plaintiffs' First interrogatories and Request for Production of Documents, dated 8/29/2013
- Kirk & Blum production documents, bates KB-0001-KB-0010, various dates
- Blacksburg Fire Department Report, bates PLTFSRSPTODUSTEX-00001-PLTFSRSPTODUSTEX-00003, dated 12/31/2010
- Plaintiff Tommy Lee Bonds' Answers to Defendant Dustex Corporation's First Set of Interrogatories, bates PLTFSRSPTODUSTEX-00004- PLTFSRSPTODUSTEX-00022, dated 5/24/2013
- Plaintiff Tommy Lee Bonds' Answers to Defendant Dustex Corporation's First Set of Requests for Production, bates PLTFSRSPTODUSTEX-00023-PLTFSRSPTODUSTEX-00033, dated 5/24/2013
- Medical Bills for Tommy Lee Bonds, bates PLTFSRSPTODUSTEX-00034-PLTFSRSPTODUSTEX-00068, various dates
- Medical Records for Tommy Lee Bonds, bates PLTFSRSPTODUSTEX-00069 - PLTFSRSPTODUSTEX-00272, various dates
- Personnel File for Tommy Lee Bonds, bates PLTFSRSPTODUSTEX-00273 - PLTFSRSPTODUSTEX-00418, various dates
- Plaintiff Jeffrey S. Hodges' Answers to Defendant Dustex Corporation's First Set of Interrogatories, bates PLTFSRSPTODUSTEX-00419- PLTFSRSPTODUSTEX-00437, dated 5/24/2013
- Plaintiff Jeffrey S. Hodges' Answers to Defendant Dustex Corporation's First Set of Requests for Production, bates PLTFSRSPTODUSTEX-00438-PLTFSRSPTODUSTEX-00448, dated 5/24/2013
- CaringBridge Journal of Jeffrey Hodges, bates PLTFSRSPTODUSTEX-00449 - PLTFSRSPTODUSTEX-00641, various dates
- Medical Bills for Jeffrey Hodges, bates PLTFSRSPTODUSTEX-00642-PLTFSRSPTODUSTEX-00750, various dates
- Medical Records for Jeffrey Hodges, bates PLTFSRSPTODUSTEX-00751 - PLTFSRSPTODUSTEX-01231, various dates

- Personnel File for Jeffrey Hodges, bates PLTFSRSPTODUSTEX-01232 - PLTFSRSPTODUSTEX-01477, various dates
- Virginia Department of Labor and Industry Citation and Notification of Penalty, bates PLTFSRSPTODUSTEX-01478 - PLTFSRSPTODUSTEX-01482, various dates
- Bundle of photos, bates PLTFSRSPTODUSTEX-01483 - PLTFSRSPTODUSTEX-01532, various dates
- Plaintiff John Paul Spangler's Answers to Defendant Dustex Corporation's First Set of Interrogatories, bates PLTFSRSPTODUSTEX-02087- PLTFSRSPTODUSTEX-02106, dated 5/24/2013
- Plaintiff John Paul Spanglers Answers to Defendant Dustex Corporation's First Set of Requests for Production, bates PLTFSRSPTODUSTEX-02107- PLTFSRSPTODUSTEX-02117, dated 5/24/2013
- Medical Bills for John Paul Spangler, bates PLTFSRSPTODUSTEX-01533- PLTFSRSPTODUSTEX-01620, various dates
- Medical Records for John Paul Spangler, bates PLTFSRSPTODUSTEX-01621 - PLTFSRSPTODUSTEX-01845, various dates
- Personnel File for John Paul Spangler, bates PLTFSRSPTODUSTEX-01846 - PLTFSRSPTODUSTEX-02084, various dates
- Virginia Department of Labor and Industry, Interview Statement of John Spangler, bates PLTFSRSPTODUSTEX-02085 - PLTFSRSPTODUSTEX-02086, dated 1/6/2011
- Subpoena documents, bates PLTFSRSPTODUSTEX-02118- PLTFSRSPTODUSTEX-02352, various dates
- Worker's Compensation correspondence, bates PLTFSRSPTODUSTEX-02353- PLTFSRSPTODUSTEX-02354, dated 8/22/2012
- Additional medical records and bills for Tommy Lee Bonds, bates PLTFSRSPTODUSTEX-02355- PLTFSRSPTODUSTEX-02367, various dates
- Additional medical records and bills for John Spangler, bates PLTFSRSPTODUSTEX-02368- PLTFSRSPTODUSTEX-02440, various dates
- Blacksburg rescue squad medical documents for Tommy Lee Bonds, bates PRD-02441 – PRD-02447, various dates

- Additional medical records for Tommy Lee Bonds, bates PRD-02448-PRD-02494, various dates
- Additional medical records for Jeffrey Hodges, bates PRD-02495-PRD-02566, various dates
- Supplemental document production of Tommy Lee Bonds, bates PRD-02567-PRD-02618, various dates
- Supplemental document production of Jeffrey Hodges, bates PRD-02619-PRD-02707, various dates
- Supplemental document production of John Spangler, bates PRD-02708-PRD-03013, various dates
- Supplemental medical records and bills of Tommy Lee Bonds, bates PRD-03014-PRD-03058, various dates
- Additional medical records of Tommy Lee Bonds, bates PRD-03059-bates PRD-03061, various dates
- Additional medical records of John Spangler, bates PRD-03062-PRD-03067, various dates
- Additional medical records of Tommy Lee Bonds, bates PRD-03068-PRD-03070, various dates
- Plaintiff John Paul Spangler Responses to Defendant's First Set of Interrogatories and Requests for Production of Documents, bates PRFM-00001-PRFM-00019, dated 12/3/2012
- Plaintiff Tommy Lee bonds Responses to Defendant's First Set of Interrogatories and Requests for Production of Documents, bates PRFM-00399-PRFM-00412, dated 12/3/2012
- Plaintiff Tommy Lee Bonds Responses to Defendant's Second Set of Interrogatories and Requests for Production of Documents, bates PRFM-01466-PRFM-01747, various dates
- Plaintiff Jeffrey Scott Hodges Responses to Defendant's Second Set of Interrogatories and Requests for Production of Documents, bates PRFM-01748-PRFM-01964, various dates

- Plaintiff John Paul Spangler Responses to Defendant's Second Second (sic) of Interrogatories and Requests for Production of Documents, bates PRFM-01965-PRFM-02001, various dates
- Plaintiffs Jeffrey S. Hodges', Tommy Lee Bonds', and John Paul Spangler's Responses to Defendant's Third Set of Interrogatories and Request for Production of Documents, bates PRFM-02002-PRFM-02062, various dates
- Plaintiffs' Responses to Defendant Federal-Mogul's Fourth Requests for Production of Documents, bates PRFM-02063-PRM-02065, dated 6/13/2013
- Security video footage file VTS_01_0.mov, dated 12/31/2010
- Security video footage file VTS_01_1.mov, dated 12/31/2010
- Photographs of Federal-Mogul, some dated 12/31/2010
- Miscellaneous photographs from internet-based news, no date
- OSHA photographs produced via an FOIA request, no date

Appendix B

Resume and List of Publications

Combustion
Science & Engineering, Inc.

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RICHARD J. ROBY, P.E., Ph.D.

EDUCATION:

Ph.D., Mechanical Engineering, Stanford University, Palo Alto, CA, Jan. 1988.
M.S., Mechanical Engineering, Cornell University, Ithaca, NY, May 1980.
B.S., Chemical Engineering, Cornell University, Ithaca, NY, May 1977.
A.B., Chemistry, Cornell University, Ithaca, NY, May 1977.

PROFESSIONAL EXPERIENCE:

President and Technical Director, Combustion Science & Engineering, Columbia, MD, 1998 to present. Responsible for day-to day operations of the company and for overseeing technical content of all research and development projects. Project manager for a variety of experimental and analytical combustion and fire science research and development programs including: development of combustion sensors for gas turbine engines; modeling of blow-off and flashback in gas turbine combustors; effects of fuel constituents on combustor performance; development and incorporation of reduced kinetics mechanisms into CFD codes; glass breakage in fires; innovative fire detection devices; fire detector response; fire model development.

Adjunct Professor, Department of Fire Protection Engineering, University of Maryland, College Park, MD, 2003 to present. Developed and teach Advanced Fire Dynamics course for FPE Master's Degree program. Served as Advisor/Thesis Committee member for several Masters students and senior research projects. Research projects have included: modeling of smoke detector activation in fires using CFD or water analogies; modeling of CO and other toxic gas uptake in fires; study of fire phenomena in residential wiring and connections; determination of detector activation by acoustic agglomeration.

Managing Member/CEO, LPP Combustion, LLC, Columbia, MD, 2004 to present.

Chairman of the Board, SafeAwake LLC, Columbia, MD, 2010 to present.

Director of Combustion Research, Hughes Associates, Inc., Baltimore, MD, 1992 to 1998. Responsible for determining scope and content of combustion research and development. Manager for variety of combustion and fire R&D programs, combustion-related projects included NOx control with water addition; catalytic reformation of natural gas for ultra-lean combustion; reduction of soot formation in methane arcjets; fire detection using multiple detection techniques; optical combustion diagnostics for gas turbines. Managed fire-related R&D programs and provided litigation support and expert witness testimony. Fire-related projects included small and large-scale fire testing, fire reconstruction, studies of formation and spread of CO, multi-sensor fire detection, code and code equivalency analyses, fire hazard analysis and fire modeling.

Adjunct Professor, Mechanical Engineering Department, Virginia Polytechnic Institute & State University, Blacksburg, VA, 1992 - 1995. Served as: Advisor/Thesis Committee member for Masters and Doctoral students; Research projects have included: experimental study of NO to NO_2 conversion at super-

atmospheric pressures; experimental study of soot formation in mixed-mode combustion; experimental study of CO generation and transport in compartment fires; Supervisor of engineering co-op student.

Associate Professor, Mechanical Engineering Department, Virginia Polytechnic Institute & State University, Blacksburg, VA, 1992 (Assistant Professor, 1986 - 1992). Taught both undergraduate and graduate courses in the thermal-fluid sciences including Combustion, Thermodynamics, Internal Combustion Engines, Experimental Methods in Thermal-Fluid Sciences and Heat Transfer. Advised thesis research for MS and PhD students. Research in combustion generated pollutant formation and control, especially NOx and soot; combustion diagnostics; compartment fire dynamics, particularly toxic species generation. Applications included spark ignition and diesel engines and aero and stationary gas turbines.

Research Assistant, Mechanical Engineering, Stanford University, Palo Alto, CA, 1983-1986.

Research Engineer, Fuels and Lubricants Department, Ford Motor Company, Scientific Research Labs, Dearborn, Michigan, 1979 - 1983.

Research Assistant, Mechanical and Aerospace Engineering Department, Cornell University, Ithaca, NY, 1977-1979.

PROFESSIONAL MEMBERSHIPS:

Member, The Combustion Institute
Member, The Society of Automotive Engineers
Member, International Association for Fire Safety Science
Member, National Fire Protection Association
Fellow, Society of Fire Protection Engineers
Member, The American Institute for Aeronautics and Astronautics
Member, The American Society of Mechanical Engineers
Member, International Gas Turbine Institute
Member, The Planetary Society
Member, Sigma Xi, The Scientific Research Society

FIRE DEPARTMENT EXPERIENCE:

Member, Van Buren Township Volunteer Fire Department, Belleville, MI, 1980-1981

Member, Ithaca Fire Department, Ithaca, NY, 1973-1979
Lieutenant, Neriton Fire Company No. 9, 1976-1979
Department Instructor, 1976-1979

HONORS AND AWARDS:

Outstanding Faculty Advisor Award – Society of Automotive Engineers, 1991

National Fire Protection Research Foundation's 1999 Harry Bigglestone Award for Excellence in Communication of Fire Protection Concepts

William M. Carey Award – 5th Fire Suppression & Detection Research Application Symposium, 2001

National Fire Protection Research Foundation's 2005 Harry Bigglestone Award for Excellence in Communication of Fire Protection Concepts

IGTI Technical Committee Best Paper Award – ASME Turbo Expo, 2005

National Fire Protection Research Foundation's 2006 Harry Bigglestone Award for Excellence in Communication of Fire Protection Concepts

National Fire Protection Research Foundation's 2007 Harry Bigglestone Award for Excellence in Communication of Fire Protection Concepts

PATENTS:

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Joklik, R. G., Roby, R. J., Klassen, M. S., Battaglioli, J. L., Hamer, A. J., Vashishat, D., "System and Method for Flame Stabilization and Control", U.S. Patent No. 7,435,080, Issued October 14, 2008

Roby, R. J., Klassen, M. S., Schemel, C. F., "System for Vaporization of Liquid Fuels for Combustion and Method of Use", U.S. Patent No. 7,770,396, Issued August 10, 2010

Roby, R. J., Klassen, M. S., Schemel, C. F., "System for Vaporization of Liquid Fuels for Combustion and Method of Use", U.S. Patent No. 8,225,611, Issued July 24, 2012

Roby, R. J. and Carpenter, D. J., "Use of Bouyant Gases for the Simulation of Real Fire Sources," U.S. Patent No. 8,413,530, Issued April 9, 2013

PROFESSIONAL REGISTRATION:

Registered Professional Engineer, Mechanical Engineering, License Number M 024534 (California 1986).

Special Skills:

Private Pilot, Instrument Rating (>1000 hours)
Scuba Diver, PADI Certified

PUBLICATIONS AND PRESENTATIONS:

Roby, R., McAllister, J.L., "Forensic Investigation Techniques for Inspecting Electrical Conductors Involved in Fire", United States Department of Justice, Document No. 239052, July 2012.

Husain, N., McAllister, J.L., Roby, R., "Analysis of Beads Formed on Energized and Non-Energized Electrical Copper Conductors Exposed to Various Thermal Insults", Proceedings from the International Symposium on Fire Investigation Science and Technology, College Park, MD, 2012.

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Klassen, M., Sutula, J., Holton, M., Roby, R. and Izbicki, T., "The 2007 Harry C. Bigglestone Award Presentation," Presented at the National Fire Protection Association World Safety Conference and Exhibition, Boston, Massachusetts, June 3-7, 2007.

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Appendix C

List of Testimony in the Last Four Years

Richard J. Roby, P.E., Ph.D.

Court and Deposition Testimony

Trial Testimony:

Carroll v Nickels
District Court for the County of Teller, State of Colorado
July 10-11, 2013

Commonwealth of Kentucky v Jerry Walker
Commonwealth of Kentucky, Calloway Circuit Court
July 16, 2012

ContiGroup Properties
United States District Court, Atlanta, Georgia
May 10, 2012

Arch Chemical v Radiator Specialty Co.
United States District Court, Portland Oregon
February 15, 2011

Deposition Testimony:

Underhill v Coleman
United States District Court, Southern District of Illinois
June 18, 2013

Kenny v Washington Gas
The Circuit Court for Montgomery County, Maryland
July 24, 2012

JoEllen Kenney v. Washington Gas Light Company et al.
The Circuit Court for Montgomery County, Maryland
July 24, 2012

ContiGroup Properties
United States District Court, Atlanta, Georgia
March 1, 2011

Solano v BP
The State of Florida
March 29, 2011

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The Circuit Court for Montgomery County, Maryland
May 23, 2011

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September 1, 2011, January 26, 2012

Erie Insurance Exchange v. Radcliffe Landscaping Inc. et al.
General Court of Justice, State of North Carolina
December 2, 2010

Raymond R. Greenwood, et al. v. Mepamsa, et al.
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October 22, 2010

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United States District Court, District of Oregon
July 15, 2010

Nancy Fischer v. Rudy Segura, et al.
State of New Mexico, County of Santa Fe, First Judicial District
May 11, 2010

The Cincinnati Insurance Company a/s/o Mid-South Industries, Inc., et al. v. CMW, Inc., et al. and Myers Industries, Inc., et al.
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February 4, 2010

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January 19, 2010

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